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Effect of Hot Water and Hydrogen Peroxide Treatments on Survival of *Salmonella* and Microbial Quality of Whole and Fresh-Cut Cantaloupe†

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ABSTRACT

Cantaloupe melon has been associated with outbreaks of salmonellosis. Contamination might be introduced into the flesh from the rind by cutting or by contact of cut pieces with contaminated rinds. Our objectives were to investigate the efficacy of hot water or hot 5% hydrogen peroxide treatments in reducing the population of native microflora and inoculated *Salmonella* on cantaloupe rind and transfer to fresh-cut tissue during cutting. Whole cantaloupes, inoculated with a cocktail of *Salmonella* serovars to give 4.6 log CFU/cm^2 and stored at 5 or 20°C for up to 5 days, were treated with hot water (70 or 97°C) or 5% hydrogen peroxide (70°C) for 1 min at 0, 1, 3, or 5 days postinoculation. Aerobic mesophilic bacteria and yeast and mold on treated whole melon and fresh-cut pieces were significantly ($P < 0.05$) reduced by all three treatments. Treatments with hot water (70 and 97°C) caused a 2.0- and 3.4-log CFU/cm^2 reduction of *Salmonella* on whole cantaloupe surfaces irrespective of days of postinoculation storage prior to treatment up to 5 days at 5 or 20°C, respectively. Treatment with 5% hydrogen peroxide (70°C) caused a 3.8-log CFU/cm^2 reduction of *Salmonella*. Fresh-cut pieces prepared from untreated inoculated melons and those treated with 70°C hot water were positive for *Salmonella*. However, fresh-cut pieces prepared from inoculated whole melon dipped in water (97°C) or hydrogen peroxide (70°C) for 60 s were negative for *Salmonella*, as determined by dilution plating onto agar medium, but were positive after enrichment at days 3 and 5 of storage at 5°C. The ability to detect *Salmonella* in fresh-cut pieces was dependent on the initial level of inoculation. The results of this study indicate that the use of hot water (97°C) or heated hydrogen peroxide to reduce the population of *Salmonella* on contaminated whole cantaloupes will enhance the microbial safety of the fresh-cut product.

Cantaloupes and other melons have been associated with numerous outbreaks of foodborne illness in recent years *(6, 8, 11, 20)*. The causative organisms in several cantaloupe-related outbreaks were *Salmonella* spp., including serotypes Chester and Poona *(6, 20)*. Other human pathogens, including *Escherichia coli* O157:H7 and *Shigella*, are capable of growth on melon flesh *(7, 12)*. The recent FDA survey of imported fresh produce reported a incidence of 5.3% positive for *Salmonella* and 2% positive for *Shigella* in 151 samples of cantaloupes, all contaminated melons originating in Mexico, Costa Rica, and Guatemala *(27)*. In a survey of domestic fresh produce *(28)*, 2.6% were positive for *Salmonella* and 0.9% were positive for *Shigella* in 115 samples of cantaloupes.

Fruits and vegetables are frequently in contact with soil, insects, animals, or humans during growing or harvesting *(22)* and in the processing plant. Thus, their surfaces are exposed to natural contaminants, and by the time they reach the packinghouse, most fresh produce retain populations of 10^4 to 10^6 microorganisms/g *(3, 5)*. Contamination most likely originates directly or indirectly from fecal matter either pre- or postharvest and could involve the use of contaminated irrigation water or uncomposted manure. Contributing factors include poor hygiene and unsanitary procedures of field and processing workers, inadequate cleaning of processing equipment, the use of decayed or damaged melons, and failure to wash melons properly before fresh-cut processing *(3, 5, 17, 18)*. The safety of fresh and fresh-cut produce in salad bars and supermarkets is a concern *(13)*.

The efficacy of sanitizer treatments in decontaminating melons has been investigated *(19)*, and population reductions of 2.6 to 3.8 log CFU/g have been reported for *Salmonella* and *E. coli* O157:H7. However, our research has shown that substantially smaller reductions are obtained when the targeted bacteria have been on the melon surface for more than a few days *(24, 25)*. We previously investigated the use of a hydrogen peroxide wash at room temperature (~25°C) for reducing attached bacteria on whole cantaloupe surfaces *(24)* and minimally processed cantaloupe *(21)*. However, decontamination with hot water washes (70 to 97°C) or heated hydrogen peroxide solutions (70°C) has not been fully explored.

Hot water decontamination of whole cantaloupes designated for fresh-cut processing could have major advantages over the use of sanitizers, including a significant reduction or elimination of vegetative cells of pathogenic bac-

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teria on melon surfaces, thus reducing the probability of potential transfer of pathogenic bacteria from the rind to the interior tissue during cutting. Our objectives were to examine the use of a hot water or heated hydrogen peroxide wash to reduce *Salmonella* and the indigenous microflora on the surface of cantaloupes designated for fresh-cut preparation. We also investigated the effect of such treatments on the transfer of pathogens from the cantaloupe surface to the fresh-cut melon during rind removal and cutting.

MATERIALS AND METHODS

Bacterial strains, growth conditions, and inoculum preparation. Bacterial strains used in this study were *Salmonella* Poona RM2350 (cantaloupe-related outbreak), *Salmonella* Stanley H0558, *Salmonella* Newport H1275, *Salmonella* Anatum F4317, and *Salmonella* Infantis F4319 (alfalfa sprout–related outbreaks) from the USDA-ARS-ERRC culture collection. Bacteria were maintained on brain heart infusion agar (BBL/Difco, Sparks, Md.) slants held at 4°C. Prior to use, the cultures were subjected to two successive transfers by loop inocula to 5 ml brain heart infusion broth (BBL/Difco). A third transfer of 0.2 ml was made into 20 ml brain heart infusion broth with incubation at 36°C for 18 h under static conditions. The strains were individually harvested by centrifugation (10,000 × *g*, 10 min) at 4°C. The cell pellets were washed twice in salt-peptone (0.85% NaCl, 0.05% bactopeptone, BBL/Difco), and the combined cell pellets were transferred to 3 liters of 0.1% peptone water (inoculum cocktail). The final bacterial concentration in the inoculum containing the mixed cocktail was 8.3 × 10^8 CFU/ml, as determined by plating serial dilutions on salmonella-shigella (SS) agar (BBL/Difco) with incubation at 35°C for 24 h. When required, the inoculum was diluted with 0.1% peptone water to lower concentrations (10^3 and 10^6 CFU/ml).

Inoculation of cantaloupes. Unwaxed cantaloupes (mean weight 1,821 ± 48 g) purchased from a local distributor were left at room temperature (~22°C) for about 18 h before being inoculated. The cantaloupes (not washed by the investigators prior to inoculation) were submerged in 3 liters of the inoculum (~20°C) containing a cocktail of the five *Salmonella* serovars at 10^3, 10^6, and 10^8 CFU/ml for 10 min, respectively, without agitation. After inoculation, the cantaloupes were drained and placed inside a biosafety cabinet on a crystallizing dish for 1 h for air drying and then stored at 5 or 20°C for up to 5 days before treatments were applied. At time 0 or after 1, 3, or 5 days, the cantaloupes were removed and exposed to treatments as stated below.

Model system for heat treatment studies. Three liters of sterile tap water in a 5-liter beaker (Pyrex) was used as the test medium. Teflon-coated thermometers (ERTCO Precision, 0 to 110°C) were placed inside the beaker. The beaker and contents were covered with three layers of aluminum foil and then brought to test temperatures of 50, 60, 70, 80, and 97°C in a circulating water bath (260 Precision Scientific Inc., Chicago, Ill.). To determine the effects of hot water treatment on native mesophilic bacteria on the cantaloupes, individual uninoculated melons stored at 20°C for 24 h were submerged in the water within each beaker at a specific test temperature for 60 s. A 5-in.-diameter lead (1,024.45 g) ring encased in plastic (Fisher Scientific, Pittsburgh, Pa.) was used to hold melons submerged underwater throughout the treatments.

In another experiment designed to study the effects of high-temperature treatments on whole cantaloupe surfaces and weight loss during storage at 4°C, individual uninoculated cantaloupes were submerged in each beaker containing water at 80°C for up to 3 min. Treated melons were placed inside a biosafety cabinet on a crystallizing dish for 15 min and then stored at 4°C for up to 29 days. Heat-treated melons and untreated controls were weighed initially and during storage to determine weight loss.

Preparation of 5% hydrogen peroxide and treatment of inoculated cantaloupes. The 5% hydrogen peroxide was prepared from a 30% stock solution (Fisher Scientific, Suwanee, Ga.) by dilution with sterile tap water. The hydrogen peroxide concentration was measured by a peroxide dip strip assay (Quantofix peroxide 25, Yanco Industrial Ltd., Burton, British Columbia, Canada). Heat treatments selected for decontaminating cantaloupe surfaces inoculated with *Salmonella* were 70°C water, 97°C water, and 5% hydrogen peroxide in deionized water at 70°C. Individual inoculated cantaloupes were submerged in 3 liters of each solution listed above for 60 s. The hydrogen peroxide solutions were prepared fresh for each trial and used for only one melon. Water temperatures at the end of 60-s treatments were 68 ± 2°C for the 70°C hot water treatment, 69 ± 2°C for the 5% hydrogen peroxide treatment, and 96 ± 2°C for the 97°C hot water treatment.

Enumeration of surviving microflora. A sterilized stainless steel cork-borer was used to cut through the cantaloupe melon surfaces at random locations to produce rind plugs of 22 mm in diameter with a rind surface area (πr^2) of 3.80 cm^2. Flesh adhering to the rind plugs was trimmed off with a sterilized stainless steel knife. Seventy rind plugs (25 g) per whole cantaloupe were blended (Waring commercial blender, Dynamic Corp., New Hartford, Conn.; speed level 5, 1 min) with 75 ml of 0.1% peptone water. Viable *Salmonella* counts were obtained by serial dilution with 0.1% peptone water and plating (0.1 ml) in duplicate on SS agar with incubation at 35°C for 48 h. For comparison, pure cultures of each individual *Salmonella* strain were plated on SS agar, incubated as described above, and run in parallel with the samples. Selected black or black-centered colonies isolated from the agar plates were confirmed to be *Salmonella* according to the *FDA Bacteriological Analytical Manual (1)*. Six representative uninoculated cantaloupes were examined by this procedure to determine whether *Salmonella* was present. Mesophilic aerobes were enumerated by plating on plate count agar (BBL/Difco) with incubation at 30°C for 3 days *(16)*. Yeast and mold were enumerated according to Booth *(4)* on Czapek malt agar (Sigma, St. Louis, Mo.).

Transfer of pathogens from the rind to the flesh during cutting. Inoculated cantaloupes stored for up to 5 days, with or without subjection to washing treatments, were cut into four sections with a sterile knife, and the rinds from each section were carefully removed with a second sterile knife. The interior flesh was cut into approximately 3-cm cubes with a third sterile knife. Fresh-cut pieces obtained from the untreated and treated whole melons were analyzed for initial microbial populations of native microflora and *Salmonella* before and during storage at 5°C for up to 15 days. The cubes (100 g) were placed in a Stomacher bag, along with 200 ml of nutrient broth (BBL/Difco) for preenrichment and pummeled for 30 s in a Stomacher (model 400, Dynatech Laboratories, Alexandria, Va.) at medium speed. A 0.1-ml aliquot was plated on all media specific for bacteria of interest as listed above. To determine surviving *Salmonella* at levels below the limit of detection by plating, homogenates also were incubated at 35°C for 18 to 22 h (preenrichment step). For selective enrichment, a 1-ml aliquot of the preenriched sample was added to 9 ml of tetrathionate broth (BBL/Difco) with incubation at 35°C for 24 h. Enrichment cultures were plated in duplicate (0.1 ml per

TABLE 1. *Transfer of native microflora of whole cantaloupe surfaces to fresh-cut pieces during cutting*[a]

Organism	Microflora population: Whole melon (log CFU/cm²)	Microflora population: Fresh-cut pieces (log CFU/g)
Mesophilic aerobes	5.6 ± 0.3	3.2 ± 0.1
Yeast and mold	2.9 ± 0.2	1.1 ± 0.2
Salmonella	ND[b]	ND

[a] Values represent means for data from three experiments with duplicate determinations per experiment.
[b] ND, not detected, even after enrichment.

TABLE 2. *Effect of hot water treatment on weight loss of whole cantaloupe stored at 4°C*

Storage time (days)	Weight loss (%)[a]: Control	80°C water: 2-min dip	80°C water: 3-min dip
8	0.5 ± 0.0	0.7 ± 0.4	1.0 ± 0.1
14	0.9 ± 0.0	1.2 ± 0.4	1.5 ± 0.1
21	1.4 ± 0.0	1.6 ± 0.3	2.4 ± 0.4
28	2.0	2.3	3.2

[a] Mean for duplicate melons ± standard deviation for days 8, 14, and 21. Weight loss on day 28 is based on single melon.

plate) on SS agar with incubation at 35°C, and isolated colonies were subjected to biochemical confirmation *(1)*.

Statistical analyses. All experiments were done in triplicate, with duplicate samples analyzed at each sampling time. Data were subjected to the Statistical Analysis System (SAS Institute, Cary, N.C.) for analysis of variance and the Bonferroni least significant difference method to determine whether there were significant differences ($P < 0.05$) between mean number of cells recovered after each treatment.

RESULTS AND DISCUSSION

Effect of hot water treatments on native microflora of whole melon. No *Salmonella* was recovered from selected whole melons before inoculation. Microbial populations on the control (uninoculated cantaloupes) surfaces averaged 5.6 log CFU/cm² for total mesophilic aerobes and 2.9 log CFU/cm² for yeast and mold (Table 1). Microbial populations transferred from whole melon to fresh-cut pieces averaged 3.2 log CFU/g for aerobic mesophiles and 1.1 log CFU/g for yeast and mold.

Results of the hot water treatment for inactivating native aerobic mesophiles on the surface of whole melons are shown in Figure 1. The most effective treatments were at a water temperature of 70°C or above. Treatment efficacy increased with time of exposure. Populations of mesophilic aerobes on cantaloupe surfaces were significantly ($P <$ 0.05) reduced when treated with hot water at 70°C or above for 30 s compared with the 50 and 60°C treatments. Population reductions on whole melon surfaces treated with hot water at 70 or 80°C for 60 s were not significantly different from each other. Treatment for 60 s with 97°C water caused a 4.4-log reduction of total mesophilic aerobes on the cantaloupe surface, whereas hot water treatments at 70°C and 80°C resulted in a 3.8-log reduction. Therefore, hot water treatments at 70 or 97°C and a contact time of 60 s were used to study inactivation of *Salmonella* on cantaloupe surfaces, and the results were compared with hot sanitizer treatments.

In a preliminary study, treated cantaloupes showed no evidence of visual damage or decay and only minimal weight loss during storage at 4°C (Table 2). Weight losses after 4 weeks at 4°C were about 2% for controls and melons treated with water at 80°C for 2 min; weight losses were about 3% for melons given a 3-min treatment. Weight loss attributable to treatment method might have resulted from disruption of natural waxes in the melon rind during exposure to 80°C water, thereby increasing the water vapor permeability of the rind. In contrast to the treated melons, untreated controls showed mold growth in the stem scar area as early as 4 days into storage at 4°C. The heat treatments significantly reduced spoilage microflora such as

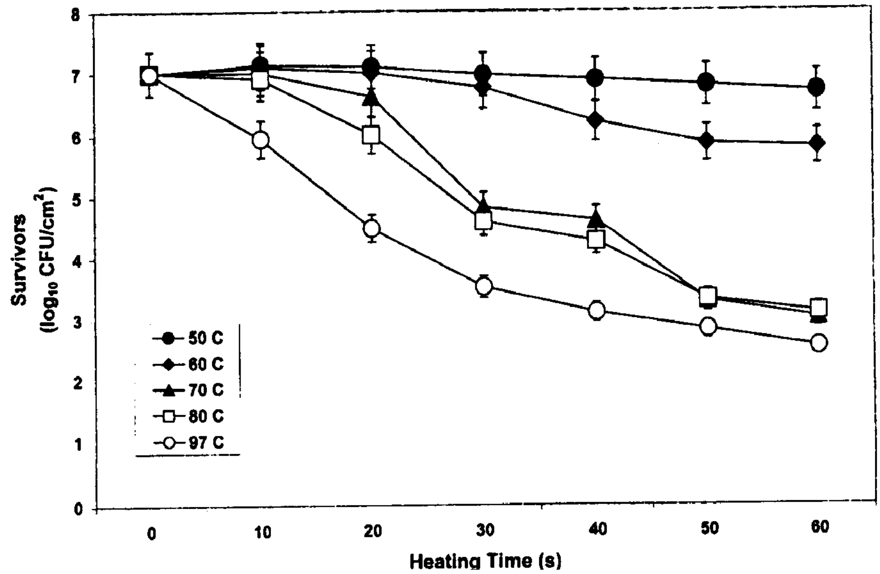

FIGURE 1. *Effect of hot water treatments on survival of native mesophilic aerobes on the surface of whole cantaloupe. Values represent mean ± standard deviation of three experiments with duplicate determinations per experiment.*

TABLE 3. *Effect of hot water or 5% hydrogen peroxide treatments on survival of native microflora and* Salmonella *on inoculated whole melon*[a]

Organism	Survival (log CFU/cm^2)[b]			
	Control	H_2O (70°C)	H_2O_2 (70°C)	H_2O (97°C)
Mesophilic aerobes	6.5 ± 0.2 A	2.3 ± 0.1 B	1.5 ± 0.1 C	1.6 ± 0.1 C
Yeast and mold	2.9 ± 0.1 A	0.7 ± 0.1 B	ND C	ND C
Salmonella[c]	4.7 ± 0.1 A	2.6 ± 0.1 B	0.9 ± 0.1 D	1.1 ± 0.2 C

[a] Values represent means for data from three experiments with duplicate determinations per experiment. Means in the same row not followed by the same letter are significantly different ($P < 0.05$). Treatments were carried out about 8 h after inoculation.
[b] Treatments were applied for 60 s. ND, not detected (<1 CFU/cm^2).
[c] Inoculum (8.3 × 10^8 CFU/ml) is a five-strain cocktail.

yeast and mold, which usually lead to decay of the whole melon and fresh-cut pieces during storage. Similar results have been reported in other fruits like peaches and nectarines immersed in water at 50°C for 2.5 min *(15)*.

Effect of hot water and sanitizer treatments on *Salmonella* on whole melons. The *Salmonella* population recovered from rind of inoculated cantaloupes about 8 h postinoculation was 4.7 log CFU/cm^2 (Table 3). *Salmonella* populations on the surface of cantaloupes declined slightly at 5°C and increased slightly at 20°C during storage for 5 days (data not shown). Exposure of melon surfaces to 97°C water and 5% hydrogen peroxide (70°C) for 1 min caused a 5.0-log reduction of total mesophilic aerobes, a 3-log reduction for yeast and mold, and a 3.6- to 3.8-log reduction for *Salmonella* (Table 3). These treatments were more effective than 70°C water for reducing mesophilic bacteria and yeast and mold on the surface of cantaloupe. Treatments also reduced the yeast and mold on fresh-cut pieces to below detection (<1 CFU), whereas low levels of aerobic mesophilic bacteria were recovered in all fresh-cut pieces prepared from treated and untreated whole melon (data not shown).

The efficacy of hot water and sanitizer treatments in reducing the population of *Salmonella* on whole cantaloupe inoculated with three different inoculum levels and stored for 3 days at 20°C is shown in Table 4. All treatments caused significant reductions ($P < 0.05$) in populations of *Salmonella*, and the average reduction for the *Salmonella* on whole cantaloupe surfaces was 2.0 log CFU/cm^2 for water at 70°C, 3.3 log CFU/cm^2 for water at 97°C, and 3.8 log CFU/cm^2 for 5% hydrogen peroxide at 70°C with an inoculum level of 10^8 CFU/ml. There were no survivors following treatment with hydrogen peroxide (70°C) and water (97°C) when the initial level of *Salmonella* on whole melon was 1.9 log CFU/cm^2. At 3.5 log CFU/cm^2, no *Salmonella* was detected on melons treated with water (97°C) and hydrogen peroxide (70°C), but samples were positive on enrichment. When treatments were applied to inoculated cantaloupes stored at 5°C for 5 days, similar reductions in the population of *Salmonella* occurred as with melons stored for 3 days (data not shown).

Tamplin *(23)* reported that attention should be directed to cleaning the melons at the time of cutting, using clean and sanitized utensils and surfaces to minimize contamination of the edible portion, and consuming the cut melon immediately or holding it at cold temperatures. Minimal reduction of spoilage mesophilic and psychrotrophic bacteria was achieved on whole and fresh-cut melon washed with 200 to 2,000 ppm chlorine *(2)*. They reported only 2- to 3-log reductions of native microflora on whole cantaloupe and honeydew melon. Ukuku et al. *(25)* reported similar results and concluded that the inability of chlorine to eliminate the microbial load of cantaloupe might be because contamination preceded washing by many days, allowing for strong microbial attachment to the melon surface and the possibility of biofilm formation by the time of washing. In a previous study *(26)*, we reported that a chlorine or hydrogen peroxide wash applied to whole cantaloupes that had been inoculated with *Salmonella* Stanley and then stored for 3 days prior to washing did not reduce the *Salmonella* population enough to preclude transfer from the rind to the interior flesh during cutting. The ability of water

TABLE 4. *Effect of inoculum level on efficacy of hot water or 5% hydrogen peroxide treatments in inactivating* Salmonella *on inoculated whole melons*[a]

Inoculum level (log CFU/ml)	Survival (log CFU/cm^2)[b]			
	Control	H_2O (70°C)	H_2O_2 (70°C)	H_2O (97°C)
8	4.7 ± 0.13 A	2.7 ± 0.1 B	0.8 ± 0.1 D	1.3 ± 0.1 C
6	3.5 ± 0.2 A	1.1 ± 0.1 B	+ C	+ C
3	1.9 ± 0.1 A	+ B	−	−

[a] Values represent means for data from three experiments with duplicate determinations per experiment. Means in the same row not followed by the same letter are significantly different ($P < 0.05$). Treatments were carried out 3 days postinoculation with storage at 20°C.
[b] Treatments were applied for 60 s. +, not detected, positive after enrichment; −, negative after enrichment.

TABLE 5. *Effect of hot water and 5% hydrogen peroxide treatments of inoculated melons on transfer of* Salmonella *to fresh-cut pieces*[a]

	Salmonella count	
Treatment[b]	Whole melon (log CFU/cm^2)	Fresh-cut pieces (log CFU/g)
Control	4.7 ± 0.1 A	2.9 ± 0.1 A
H_2O (70°C)	2.6 ± 0.1 B	0.7 ± 0.1 B
H_2O_2 (70°C)	0.9 ± 0.1 C	+
H_2O (97°C)	1.1 ± 0.2 C	+

[a] Values represent means for data from three experiments with duplicate determinations per experiment. Means in the same row not followed by the same letter are significantly ($P < 0.05$) different. Whole melon inoculated with mixed cocktail at 8.3×10^8 CFU/ml. Treatments were carried out at 3 days postinoculation with storage at 5°C. Fresh-cut pieces were prepared and sampled immediately after treatments. +, positive after enrichment.

[b] Treatments were applied for 60 s.

at 97°C or 5% hydrogen peroxide at 70°C to achieve population reductions approaching 4 log is a substantial improvement and represents an effective and practical means of decontamination when the attached microflora might be resistant.

Effect of hot water and sanitizer treatment on transfer of *Salmonella*. Table 5 shows the efficacy of hot water and sanitizing treatments in reducing the population of *Salmonella* on whole melon surface sufficiently so that transfer of this pathogen to the cantaloupe flesh during fresh-cut preparation is greatly reduced. Fresh-cut tissues prepared from inoculated whole cantaloupes (1.9 to 3.5 log CFU/cm^2) that had been treated with 97°C water or 5% hydrogen peroxide at 70°C, but not water at 70°C, 3 days postinoculation with storage at 5°C were negative for *Salmonella* by direct plating and following enrichment. The effect of these treatments on the transfer of *Salmonella* from cantaloupe surfaces inoculated at different levels to fresh-cut pieces is shown in Table 6. Although all treatments significantly reduced the *Salmonella* population on whole melon (Table 4), fresh-cut pieces prepared from treated whole melon with an initial *Salmonella* population of 4.7 log CFU/cm^2 were positive for the pathogen with enrichment. Fresh-cut pieces prepared from cantaloupes inoculated with 3.5 log CFU/cm^2 and treated with hydrogen peroxide at 70°C or water at 97°C were negative for *Salmonella* after enrichment; treatment with 70°C water yielded positive samples after enrichment. No *Salmonella* could be detected in fresh-cut cantaloupes after enrichment when the melons were inoculated at 1.9 log CFU/cm^2 and then treated. However, during storage at 5°C, fresh-cut pieces from cantaloupes inoculated with 3.5 log CFU/cm^2 *Salmonella* and treated with 97°C water became positive after 12 days (data not shown). This delayed detection might be the result of recovery of injured cells.

Water at 97°C and 5% hydrogen peroxide at 70°C were effective in reducing *Salmonella* populations sufficiently on the surface of treated whole melons, so that transfer from the cantaloupe surfaces to the fresh-cut pieces was below detection. Also yeast and mold on fresh-cut pieces were reduced to below detection (data not shown), whereas low levels of aerobic mesophilic bacteria were recovered in all fresh-cut pieces prepared from treated and untreated whole melon.

Application of heat treatments used for this study can be extended to inactivate human bacterial pathogens on other melons where the rind is thick and dense so that heat exposure of the internal flesh is minimal and the eating quality of the melon will not be affected. A more than 5-log reduction of *E. coli* O157:H7 on inoculated whole apple treated with hot water at 80 and 90°C for 15 s has been reported *(10)*.

Transfer of *Salmonella* from the surface of tomatoes to the interior during cutting has been reported *(14)*. The data suggested that the rate of bacterial transfer is dependent on inoculum size on the stem scar. In our study, we observed less than the detectable limit in fresh-cut pieces prepared from untreated whole melons with 2.0 log CFU/cm^2 *Salmonella*, but detectable levels in pieces from melons with higher populations. *Salmonella* Miami and *Salmonella* Bareilly were responsible for two salmonellosis outbreaks associated with precut wrapped watermelon *(9)*. The investigators showed that the interior watermelon tissue could be contaminated if *Salmonella* was present either on the rind of the watermelon or on the knife used for slicing. *Salmonella* Stanley transferred from the rind to the fresh-cut cubes has the potential to grow when nutrients are available if the temperature is favorable *(26)*. Other investigators *(9, 11, 12)* have reported that interior watermelon tissues support the growth of *Salmonella* spp.

Hot water decontamination of whole cantaloupes des-

TABLE 6. *Effects of inoculated level and hot water or 5% hydrogen peroxide treatments on survival of* Salmonella *on cantaloupe surface and transfer onto fresh-cut melon pieces*[a]

		Presence of inoculated bacteria[b]			
Inoculum level (log CFU/ml)	Initial population (log CFU/cm^2)	Control	H_2O (70°C)	H_2O_2 (70°C)	H_2O (97°C)
8	4.7 ± 0.1	+	+	+	+
6	3.5 ± 0.2	+	+	−	−
3	1.9 ± 0.1	+	−	−	−

[a] Inoculated melons stored at 4°C for 3 days prior to treatment; treatments were applied for 60 s.

[b] Determination was after enrichment steps. +, positive; −, negative.

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ignated for fresh-cut processing could have major advantages over the use of sanitizers, providing significant reduction of pathogenic bacteria on melon surfaces, thus reducing the probability of potential transfer of pathogenic bacteria from the rind to the interior tissue during cutting. The results of this study indicate that exposing cantaloupe surfaces to 5% hydrogen peroxide at 70°C or water at 97°C for 60 s can achieve this result. Use of such treatments could reduce the risk of enteric disease through consumption of melons contaminated at the surface with human pathogens.

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